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KANSAS STATE UNIV MANHATTAN DEPT OF COMPUTER SCIENCE
FUNCTIONALLY DISTRIBUTED COMPUTING SYSTEMS: USER FACILITY DEVEL--ETC(U)
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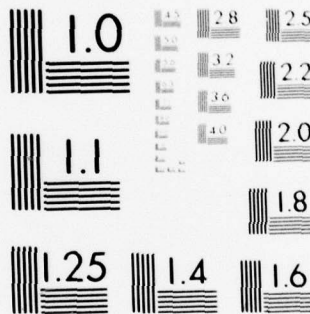


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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER (19) 15552.1-EL		2. GOVT ACCESSION NO. (18) ARO		3. RECIPIENT'S CATALOG NUMBER (12)	
4. TITLE (and Subtitle) (16) FUNCTIONALLY DISTRIBUTED COMPUTING SYSTEMS: USER FACILITY DEVELOPMENT				5. TYPE OF REPORT & PERIOD COVERED (9) Final Report 1 Jan 78 - 31 Jan 79	
6. AUTHOR(s) (10) Fred Maryanski				7. PERFORMING ORG. REPORT NUMBER (15) DAAG29-78-G-0018	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Department of Computer Science Kansas State University Manhattan, KS 66506				10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS (11) 34 Jan 79	
11. CONTROLLING OFFICE NAME AND ADDRESS U. S. Army Research Office P. O. Box 12211 Research Triangle Park, NC 27709				12. REPORT DATE Jan 31, 1979	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) School of Aerospace Medicine Brooks Air Force Base San Antonio, TX 78235				13. NUMBER OF PAGES 10	
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited. (12) 13 p				15. SECURITY CLASS. (of this report) Unclassified	
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)				15a. DECLASSIFICATION/DOWNGRADING SCHEDULE	
18. SUPPLEMENTARY NOTES The view, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.					
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Distributed processing, PDP 11/70, PDP 11/34, School of Aerospace Medicine Distributed computing, Minicomputer Networks, Network simulation					
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Under a grant from the Army Research Office, Kansas State University investigated and studied the feasibility of establishing the multiple minicomputers of the School of Aerospace Medicine into a network of computer resources. A PDP 11/70 and a PDP 11/34 were acquired for use as host computer in a distributed processing configuration. Simulations were written to test the network concept prior to installation. The report describes the result of the investigation.					

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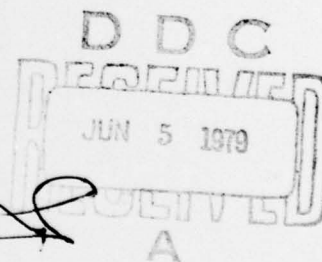
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FINAL TECHNICAL REPORT
FUNCTIONALLY DISTRIBUTED COMPUTING SYSTEMS:
USER FACILITY DEVELOPMENT

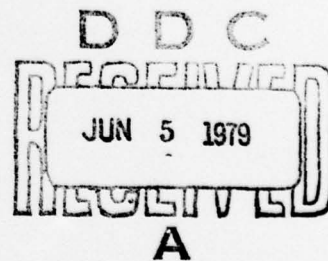
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January 31, 1979

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Fred Maryanski
Principal Investigator



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I. INTRODUCTION

The technical work performed under the grant is summarized in this document. For the most part, research and development efforts are presented in an overview fashion with details available in the technical reports referenced throughout the text. The material is organized roughly, but not exactly, according to the format of the project plan. However, the sequence of that document has not been followed precisely since the effort in some areas is so closely interrelated that individual descriptions of the areas would produce considerable redundancy.

The work on this project has been evolutionary in nature. The initial schedule proposed in the project plan has not been followed very closely for two main reasons. The most obvious cause of the schedule modifications was the time of the hardware delivery. All parties associated with the procurement were extremely optimistic in setting the expected delivery date. The actual delivery and installation occurred six months later than originally was targeted, thus producing havoc in our twelve month timetable. The other main reason for certain departures from the original plan was the changing needs of the personnel at the School of Aerospace Medicine (SAM). The entrance into the technology of functionally distributed computing was a new experience. When the initial plan was formulated, it was not possible to predict the effects of this new approach to computing on the SAM environment.

Thus, some of the original items presented in the project plan become either trivial, impossible, or irrelevant. In the interest of all parties, such situations were handled by redirecting the efforts of the affected personnel.

The remainder of this document summarizes the technical effort expended in the following areas--hardware acquisition and interface, training, simulation, database systems, distributed databases, user interface.

II. HARDWARE ACQUISITION AND INTERFACE

Without a doubt, the most significant benefit accrued by the Air Force from this project is the acquisition of the PDP 11/70 computer system. This machine will serve as the focal point of computing within the School of Aerospace Medicine for several years and provides the basis for the development of a functionally distributed computing network. In addition to the PDP 11/70, a PDP 11/34 was procured for use by personnel at Kansas State University. This machine will revert to SAM as soon as the necessary arrangements can be completed. The PDP 11/34 will serve as a key machine in the computer network to be implemented at SAM.

Since the School of Aerospace Medicine owned a card reader, line printer, and a plotter for their existing IBM system, it was hoped that these peripherals could be interfaced to the new computer. Initially, this approach appeared attractive. However, all efforts toward achieving such an interface through either purchase or design proved

unsuccessful. In order to provide SAM with the necessary peripherals, a card reader and line printer were diverted from KSU to San Antonio.

The personnel at SAM require access to IBM and UNIVAC mainframes residing at remote sites. Since the PDP 11/70 will be providing interactive computing facilities to the SAM personnel, a natural extension is to establish a mechanism for Remote Job Entry to both the IBM and UNIVAC computers on the PDP 11/70. The problem of IBM 370 interface to the PDP 11/70 faces many users, and Digital Equipment Corporation (DEC) does market software packages for this purpose. Unfortunately, the DEC representatives guided us to the purchase of the wrong package. An attempt to obtain the proper software is in progress and is expected to be successful.

The UNIVAC machine at the HRL on Brooks Air Force Base requires an NTR interface which is not marketed by DEC. A search of vendors and users has located a small number of packages that may be adaptable to the SAM environment.

The ultimate plan for the hardware procured during the course of the grant is the establishment of a computer network linking computers to the central PDP 11/70. One alternative that was considered in the early stages of the grant was to use the network software developed at Kansas State University in the synthesis of the SAM network. However, the uncertainty of a long-term maintenance arrangement rendered this approach infeasible. Therefore,

the DECNET software package was procured from the hardware vendor.

III. TRAINING

Originally, the training effort was to be aimed at educating SAM system programmers on the use and maintenance of software developed at the university. Due to the changes in the emphasis of the KSU effort, the training portion of the grant work was redirected. Two courses in the BASIC programming language were offered to SAM personnel in January 1979. The first course was intended for first time computer users, while the second course was geared toward programmers with experience in languages other than BASIC. The feedback on these courses has been positive. The courses have contributed toward making the new computing facility available to a larger segment of the SAM population.

IV. SIMULATION

Since the prime language goal for the SAM computing facility is the development of a computer network, a simulation model has been developed to aid in the network design process. A series of GPSS simulation models was developed to describe the network in its various stages of development. References [5,8,11] describe the simulation models. The first two reports describe models of the PDP 11/70 in a stand-alone environment. The second report

describes revisions made to the model of the first report and actually supersedes the first report. The central model attempts to characterize the utilization of resources on the PDP 11/70 when its full complement of thirty-two interactive terminals becomes available. The network models reported in the third document simulate the incremental growth of the network as laboratory computers are incorporated into the network. Models of both star and hierarchical networks have been created in order to determine the effects of different configurations on performance and resource utilization.

The delay in the hardware delivery had a substantial impact upon the simulation modeling effort since the possibility of collecting user job stream information was eliminated. Thus the simulation models are parameterized to describe hypothetical user environments. However, the GPSS programs are sufficiently flexible so that the model can be modified when a more accurate profile of the SAM user environment can be obtained.

The results of the simulation experiments project that if the vendor's guidelines in terms of message rates and CPU utilization are followed, three laboratory machines can be attached to the PDP 11/70 with little discernible effect upon performance. Attaching six or more machines in either star or hierarchical configurations may result in a decrease in throughput for the interactive users on the PDP 11/70 or some network bottlenecks. However, the effect on the PDP 11/70, though noticeable, is not expected to be

catastrophic. A constraint of the network that became apparent during the simulation effort is that the 19.2K baud intermachine line is not fast enough to support the traffic that would be introduced by the addition of a dedicated repository (backend) machine or a specialized statistical processor. The addition of either type of dedicated computer requires higher speed communication lines.

V. DATABASE SYSTEMS

The efforts on database management systems are divided into two parts. Research on distributed database systems is described in the next section. A separate area of emphasis was consultation on more immediate database problems facing SAM. This is one of the areas of effort that underwent a radical redefinition of direction. The initial effort focused upon enhancement to the System 2000 package utilized by SAM personnel on the HRL computer. Our role in this effort was to serve as an intermediary between the vendor and the Air Force to determine a practical set of enhancements that would satisfy SAM's requirements. After some initial meetings, contractual difficulties prevented our further participation in the project.

Our efforts were then redirected to the selection of a DBMS for use on the PDP 11/70. An extensive list of selection criteria was formulated and weighting factors assigned to each item in the list. The initial weighted list was submitted to SAM for review and adjustment of

weights and to emphasize the relative importance of the various items.

Eight candidate DBMS packages were identified by canvassing the industry for available PDP/11-based database systems. Each package was graded on every item in the selection list. The grading was performed using the information obtained in vendor-supplied documentation. For each package, the grades for the individual items were multiplied by the weights and then summed to determine the overall score. The top three packages were then recommended to SAM for further consideration. SAM personnel selected DBMS-11, marketed by Digital Equipment Corporation, which ranked first in our evaluation.

VI. DISTRIBUTED DATABASES

The primary basic research area of the grant was distributed database. The development of a distributed database system on the SAM computing network is a long-term goal for the School. Therefore, a substantial amount of research on distributed databases was carried out. The emphasis was on the theoretical problems of user-transparent access to distributed data and the maintenance of consistent copies of redundant data in a distributed database system. The practical problems of designing and implementing prototype systems were addressed using software and hardware available at Kansas State University. Although the prototype systems utilized computers and DBMS packages not

found at SAM, the experience in the prototyping effort is applicable to any environment. An additional study generalized the results of prior work and put forth a framework for the synthesis of minicomputer-based distributed management information systems.

References [1,3,4,6,7,9,10] describe the distributed database research. This will have little immediate impact upon computing at SAM. However, as the network facility continues to evolve, the ideas contained in these reports should be helpful in the creation of a distributed database system.

VII. USER INTERFACE

In the early stages of the project, a need for a machine interface for the nonprogramming user was defined. A study was initiated to determine the feasibility of constructing such an interface during the course of the grant. The first step of the study was to analyze the existing literature to determine the state-of-the art of such systems. The results of this initial investigation indicated that such interfaces must be tied to software packages such as information retrieval or database management systems. As a result of this study, a user interface system was designed to provide the nonprogramming user with easy access to either a textual information or database management system. The principal problem with the proposed design was the aforementioned requirement of a

sophisticated software system to provide data access. Since a database management system is not yet available on the PDP 11/70, the project was not pursued beyond the design phase. Reference [2] describes the work in the user interface area.

VIII. CONCLUSION

The work on this grant spanned a broad spectrum of activities from procurement actions to basic research. As mentioned earlier, delays in hardware delivery plus the evolving needs of the SAM personnel produced a substantial number of changes in the direction of the grant. In some cases, the personnel allocations made at the initiation of the grant were not well suited to the tasks that evolved during its term.

Although some difficulties arose, the grant did mark the beginning of the development of an up-to-date user-oriented computer facility at the School of Aerospace Medicine. This is a very significant positive result of the grant. It is hoped that the basic research performed on distributed databases will lead to some equally visible benefits as the distributed computing facility at the School of Aerospace Medicine continues to evolve.

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